

What I Claim Is:

1. A fuel injector comprising:

a coil group subassembly being independently testable, the coil group subassembly including:

a solenoid coil;

a coil housing surrounding a portion of the solenoid coil; and

a first attaching portion disposed on the housing; and

a valve group subassembly being independently testable, the valve group subassembly including:

a tube assembly having a longitudinal axis extending between a first tube end and a second tube end, the tube assembly having a second attaching portion contiguous to the first attaching portion, the first and second attaching portions being fixedly connected proximate the second tube end;

an armature assembly disposed in the tube assembly, the armature assembly having a closure member; and

a seat assembly disposed in the tube assembly proximate the second tube end, the seat assembly including:

a flow portion, the flow portion extending along the longitudinal axis between a first surface and an orifice disk retention surface at a first length, the flow portion having a seat orifice extending therethrough;

an orifice disk coupled to the orifice disk retention surface so that the orifice plate is aligned in a fixed spatial orientation with respect to the flow portion; and

a securement portion, the securement portion extending along the longitudinal axis away from the orifice disk retention surface at a second length greater than the first length.

2. The fuel injector of claim 1, further comprising at least one weld extending from an outer surface of the tube assembly to the outer surface of the securement portion at a location distal to the

flow portion so that the seat and the orifice disk generally maintains its fixed spatial orientation with the flow portion.

3. The method of claim 1, further comprising at least one weld extending from an outer surface of the tube assembly to the outer surface of the securement portion at a location distal to the flow portion so as to form a generally hermetic seal between the tube assembly and the seat.

4. The method of claim 1, further comprising at least one weld extending from an outer surface of the tube assembly to the outer surface of the securement portion at a location distal to the flow portion so that the seat maintains a dimensional symmetry about the longitudinal axis after the application of the at least one weld.

5. The fuel injector of claim 1, wherein the at least one weld is located on the outer surface of the tube assembly at a length of approximately 50% of the second length along the longitudinal axis.

6. The fuel injector of claim 5, wherein the tube assembly comprises:
an inlet tube having a first end and a second end being coupled to a valve body, the second end of the inlet tube having an end portion confronting an end portion of the armature;
a filter being disposed proximate the first end of the inlet tube;
a resilient member having one portion disposed proximate the second end of the inlet tube and another portion disposed within a pocket in the armature;
an adjusting tube being located within the inlet tube, the adjusting tube engaging the one portion of the resilient member so as to bias the closure member towards a position occluding flow through the seat orifice.

7. The fuel injector of claim 6, wherein the inlet tube, filter, resilient member, adjusting tube, magnetic coil, valve body, armature assembly and seat are symmetrical about the longitudinal axis.

8. The fuel injector of claim 7, wherein the armature assembly comprises a non-magnetic armature tube connecting an armature to a closure member, the non-magnetic armature tube decoupling a flow of magnetic flux between the armature and the seat.
9. The fuel injector of claim 8, wherein the closure member comprises a spheroidal member having a diameter greater than the diameter of the armature tube.
10. The fuel injector of claim 9, wherein the inlet tube further comprises a first tube coupled to a pole piece.
12. The fuel injector of claim 10, wherein the flow portion comprises:
first and second spaced apart generally planar surfaces disposed about the longitudinal axis, the first and second spaced apart surfaces; and
a sealing surface co-terminus with one of the first and second spaced apart generally planar surfaces and contiguous to the seat orifice.
13. The fuel injector of claim 12, wherein the securement portion comprises:
a perimeter cincturing the flow portion and extending along the longitudinal axis between a first perimeter end and a second perimeter end over a third length greater than the second length.
14. The fuel injector of claim 13, wherein seat further comprises a guide member contiguous to the first perimeter end of the seat, the guide member being provided with a central through opening along the longitudinal axis and a plurality of through openings disposed about the central opening, the central through opening guiding the closure member along the longitudinal axis between the first position where the closure member occludes fuel flow through the seat orifice and the second position where the closure member is spaced from the seat orifice so as to permit fuel flow through the seat orifice.

15. The fuel injector of claim 14, wherein the seat further comprises an orifice disk connected to the second surface of the seat, the orifice disk having a plurality of through openings being disposed about the longitudinal axis and in fluid communication with the seat orifice.

16. The fuel injector of claim 15, wherein the armature tube comprises at least one opening generally orthogonal to the longitudinal axis and extending through the surface of the armature tube.

17. The fuel injector of claim 15, wherein the armature tube comprises an inner surface telescoping over an outer surface of a first portion of the armature, the inner surface of the armature tube being connected to the outer surface of the armature by at least one weld extending from the inner surface of the armature tube to the outer surface of the armature.

18. The fuel injector of claim 17, wherein the armature tube comprises a deep drawn tube.

19. The fuel injector of claim 17, wherein the armature tube comprises a tube having a length with respect to the longitudinal axis greater than a length of the armature with respect to the longitudinal axis.

20. The fuel injector of claim 5, wherein the armature assembly comprises an armature portion and a tubular portion, the tubular portion being connected to a closure member by at least one weld.

21. The fuel injector of claim 20, wherein the pole piece and armature portion comprise respective end face portions generally orthogonal to the longitudinal axis and one of the end face portions having a surface oblique to the longitudinal axis, the oblique surface including a coating being formed thereon.

22. The fuel injector of claim 5, wherein the coil housing comprises a first housing portion cincturing a portion of the solenoid coil and a second housing portion cincturing a portion of the valve body, the second housing portion having a flange to retain a sealing member.

23. A method of maintaining a fixed spatial orientation of a seat and an orifice disk in a valve subassembly, the valve subassembly extending along a longitudinal axis, the method comprising:
disposing the seat and the orifice disk in a valve body of the valve subassembly in a fixed spatial orientation; and
welding the seat to the valve body so that the fixed spatial axial orientation is maintained within a tolerance of $\pm 0.5\%$.
24. The method of claim 23, wherein the welding comprises laser welding through from an outer surface of the tube assembly to the outer surface of the securement portion at a location distal to the flow portion so that the symmetry of each of the seat and the orifice disk about the longitudinal axis is within a magnitude of less than 1% in the difference between any dimensional change of the seat about the longitudinal axis.
25. The method of claim 23, wherein the laser welding comprises forming a continuous weld on a securement portion of the seat at about 50% of the length of a flow portion of the seat along the longitudinal axis.
26. The method of claim 24, wherein the laser welding comprises forming a hermetic lap weld between the inner surface of the body and the circumferential surface of the securement portion.
27. The method of claim 26, wherein the disposing of the seat comprises:
forming the flow portion having first and second spaced apart generally planar surfaces over a first length, the flow portion having a sealing surface co-terminus with one of the first and second spaced apart generally planar surfaces and contiguous to the seat orifice, and a orifice disk retention surface contiguous with the seat orifice on the other of the first and second generally planar surface; and
welding an orifice disk to the orifice disk retention surface in the fixed spatial orientation of the orifice disk relative to the orifice disk retention surface.

28. The method of claim 27, wherein the providing comprises:

forming a perimeter defining the securement portion, the perimeter cincturing the flow portion and extending along the longitudinal axis between a first perimeter end and a second perimeter end over a second length greater than the first length;

connecting a generally planar closure guide member to the first perimeter end of the seat so as to form a seat assembly; and

press-fitting the seat assembly in the tube assembly to a predetermined distance within the tube assembly.